APPLICATION UNDER UNITED STATES PATENT LAWS

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Invention: DIGITAL RECORDING/REPRODUCING APPARATUS

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This is a:

☐ Provisional Application

☒ Regular Utility Application

☐ Continuing Application
   ☐ The contents of the parent are incorporated
     by reference

☐ PCT National Phase Application

☐ Design Application

☐ Reissue Application

☐ Plant Application

☐ Substitute Specification
   Sub. Spec Filed _____
          in App. No. _____/_____

☐ Marked up Specification re
   Sub. Spec. filed _____
          In App. No _____/_____

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SPECIFICATION

TITLE OF THE INVENTION

DIGITAL RECORDING/REPRODUCING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the
benefit of priority from the prior Japanese Patent
Application No. 2001-140276, filed May 10, 2001, the
entire contents of which are incorporated herein by
reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to improvement of
a digital recording/reproducing apparatus which uses
a removable optical disc. The present invention
relates particularly to a technique for eliminating
intricacy regarding a recording setting associated with
sound in a DVD recorder in which a plurality of types
of sound languages (English, Japanese, and the like),
a plurality of types of sound modes (monaural,
dual-monaural, stereo, and the like) and a plurality of
types of video formats (DVD video, DVD real-time
recording, and the like) are supported.

2. Description of the Related Art

In recent years, an optical disc reproducing
system in which audio-visual (AV) information including
a dynamic image is recorded has been developed, and has
generally spread for a purpose of movie software,
karaoke, and the like. Above all, DVD video has

remarkably spread. For a standard of DVD video, in
accordance with a MPEG2 system layer, MPEG2 is
supported in a dynamic image compression system, and AC
audio and MPEG audio are supported in sound. Moreover,

5   in the DVD video standard, sub image data in which bit
map data is subjected to run length compression for
subtitle and menu, and special control data (navigation
pack) for special reproducing such as fast
forward/rewind are defined. Furthermore, in the DVD

10   video standard, ISO9660 and micro UDF (UDF bridge) are
supported so that data can be read with a computer.
As the standard of an information medium itself for
storing AV information, following DVD-ROM as media for
use in DVD video, standards of DVD-RAM (repeatedly

15   readable/writable), DVD-R (write once), and DVD-RW
(repeatedly rewritable) have been completed. Moreover,
DVD-RAM drive (or DVD-R/DVD-RW drive) has also started
to spread as computer peripherals.

    At present, the standard of DVD-real-time

20   recording (RTR) has been completed as DVD standard
which utilizes DVD-RAM (or DVD-R/DVD-RW) and which
is recordable/reproducible in real time, and
a verification operation ended in spring, 2000.
This standard is based on the standard of the presently

25   spread DVD video (DVD-ROM). A file system for
the DVD-RTR has also been standardized. Under these
situations, DVD video recorder based on the DVD-RTR

standard has started to be on the market.

Many of DVD recorders now on the market support both formats of the DVD video and DVD-RTR. These are formats of the same DVD family. Unless both formats are supported, commercial property (appeal to a buyer layer) of DVD recorder is remarkably deteriorated.

However, even when both formats are supported, the formats have no correlation with respect to various initial settings, and settings are completely different. Therefore, even with the single recorder, a user needs to individually perform a similar setting with respect to both formats (in both modes). A problem occurs that the settings become intricate.

BRIEF SUMMARY OF THE INVENTION

In a digital recording/reproducing apparatus according to an embodiment of the present invention, a sound language setting in a second format (DVD-RTR) can be matched with the sound language setting in a first format (DVD video).

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a block diagram showing the whole constitution of a digital recording/reproducing apparatus (DVD-RTR video recorder) with a sound changeover function according to one embodiment of the present invention.

FIG. 2 is a diagram showing a directory structure of an information file recorded by the apparatus of

FIG. 1.

FIG. 3 is a diagram showing a data structure of information (video object) recorded by the apparatus of FIG. 1.

FIG. 4 is a diagram showing a data structure of management information (M_VOB_STI, and the like) recorded by the apparatus of FIG. 1.

FIG. 5 is a diagram showing a pack structure of audio information (linear PCM audio) recorded by the apparatus of FIG. 1.

FIG. 6 is a diagram showing a pack structure of audio information (MPEG audio) recorded by the apparatus of FIG. 1.

FIG. 7 is a flowchart showing the whole operation of the apparatus of FIG. 1.

FIG. 8 is a flowchart of an operation for selecting a broadcast program in the apparatus of FIG. 1.

FIG. 9 is a flowchart of a recording operation in the apparatus of FIG. 1.

FIG. 10 is a flowchart of an interrupt processing in the apparatus of FIG. 1.

FIG. 11 is a flowchart of a setting processing of stream information (STI) in the apparatus of FIG. 1.

FIG. 12 is a flowchart of an encoding processing of audio data in the apparatus of FIG. 1.

FIG. 13 is a flowchart showing the whole

reproducing operation (former half) in the apparatus of FIG. 1.

FIG. 14 is a flowchart showing the whole reproducing operation (latter half) in the apparatus of FIG. 1.

FIG. 15 is a flowchart showing a cell reproducing processing (former half) in the apparatus of FIG. 1.

FIG. 16 is a flowchart showing the cell reproducing processing (latter half) in the apparatus of FIG. 1.

FIG. 17 is a diagram showing contents of management information to be recorded by the apparatus of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

A digital recording/reproducing apparatus (DVD-RTR recorder) according to one embodiment of the present invention will be described hereinafter with reference to the drawings. FIG. 1 is a block diagram showing a whole constitution of a digital recording/reproducing apparatus (DVD-RTR video recorder) with a sound changeover function according to one embodiment of the present invention. The apparatus basically performs real-time video recording using a recordable optical disc (DVD-RAM disc, DVD-RW disc, DVD-R disc) 100, and includes a reproducing function of an optical disc for exclusive use in reproducing (DVD-ROM disc, recorded DVD-R disc).

The apparatus of FIG. 1 is constituted of: an encoder section 601; a decoder section 602; a main microcomputer (MPU) section 604: a video (V) mixing section 605; a frame memory 606; a key input section 607; a display 608; a DVD-RAM (and/or DVD-R/DVD-RW) drive 609; a data processor (D-PRO) 610; an A/V input 612; a TV tuner 613; an audio digital I/F 631; an audio D/A section 632; a speaker 633 (a driving audio amplifier is not shown); a video digital I/F 634; a TV D/A section 636; an external monitor TV 637; a system time counter (STC) 650; a temporary storage (large-capacity IC memory and/or HDD recorder unit) 700; a selector 750 of an audio signal; a bilingual broadcast detector (multilingual detector) 900; and the like.

A main MPU section 604 has therein a stream information (STI) setter 6044 and other control program (firmware). Moreover, the MPU section 604 has therein a work RAM 604a for use in executing the control program. A management information (VMG) holder 6043 is disposed in the work RAM 604a.

The encoder section 601 is constituted of an A/D section 614; a video encoder 616; an audio encoder 617 including a dual-monaural header setter 617a; a subpicture (SP) encoder 618; a formatter 619; and a buffer memory 620. Moreover, the decoder section 602 is constituted of a separator 625 including a memory

626, a video decoder 628 including a reduced image
(thumb nail) generator 628a, a subpicture (SP) decoder
627, an audio decoder 630, and a video processor
(V-PRO) 638.

5   Recording (recording of AV information) is
performed by the disc drive (DVD-RAM drive) 609, in
which the removable DVD-RAM (or DVD-R/DVD-RW) disc 100
is used, via the encoder section 601. The disc
drive 609 can play back not only the DVD-RAM

10   (or DVD-R/DVD-RW) disc 100 but also the DVD video
(or DVD-ROM) disc 100. That is, reproducing is
performed using the disc drive 609 via the decoder
section 602. The function of playing back the DVD
video is basically the same as a DVD video player

15   generally on the market.

A flow of an actual video signal in the apparatus
of FIG. 1 is as follows. First, an analog AV signal
inputted via the A/V input 612 or an analog TV signal
obtained from the TV tuner 613 is converted to

20   a digital signal in A/D section 614 of the encoder
section 601. The video signal subjected to digital
conversion is inputted to the video encoder 616, and
the audio signal subjected to digital conversion is
inputted to the audio encoder 617. Moreover, character

25   broadcast data and other character data obtained from
the TV tuner 613 are inputted to the subpicture (SP)
encoder 618. The inputted video signal is MPEG

compressed in the video (main picture) encoder 616.
The inputted audio signal is subjected to the AC3
or MPEG audio compression in the audio (sound)
encoder 617. Moreover, the inputted character data

5   is subjected to run length compression in the SP
encoder 618.

For the respective encoders 616 to 618, the data
is packeted to indicate 2048 bytes when the compressed
data is packed, and the packeted video data, audio data

10 and subpicture data are inputted to the formatter 619.
The formatter 619 appropriately uses the buffer memory
620, packs and multiplexes the inputted packet data,
and sends the multiplexed video pack, audio pack and
subpicture pack to the D-PRO 610.

15 The D-PRO 610 forms an ECC block for every 16
packs (32 or more packs in a next-generation DVD video)
in the present DVD video, and attaches error correction
data to the block. A data stream obtained in this
manner is recorded in the optical disc (DVD-RAM, DVD-RW

20 or DVD-R) 100 by the disc drive 609. Here, with the
disc drive 109 in a busy state for seeking or track
jump, the recorded data is stored in the temporary
storage 700 (IC memory and/or HDD recorder unit), until
the disc drive 609 is prepared for recording the data.

25 Furthermore, the formatter 619 prepares respective
segmenting information during recording (by interrupt
in a top of GOP), and periodically sends the prepared

segmenting information to the MPU section 604.
Examples of the segmenting information include the
number of packs of a video object unit (VOBU), end
address of one picture from the top of VOBU,

5   reproducing time of VOBU, and the like. Each VOBU
includes the video pack, and audio pack and/or
subpicture pack. The information can be accessed by
the unit of the VOBU. Additionally, one video file is
disposed in one disc in DVD-RTR (recording/reproducing

10   DVD).

     The TV broadcast signal is received by the TV
tuner 613. The sound signal of the TV broadcast signal
can have a plurality of sound modes. The sound signal
received by the TV tuner 613 is, for example, monaural

15   (L = R), stereo (L&R), or bilingual (multilingual),
that is, dual-monaural (L = main sound/Japanese),
R = sub sound/foreign languages, and the like).
The bilingual broadcast detector (multilingual
detector) 900 detects whether or not the received

20   sound signal is bilingual (multilingual), that is,
dual-monaural. The information detected by the
bilingual broadcast detector 900 is inputted to the
encoder section 601 and main MPU section, and subjected
to various settings (described later with reference to

25   flowcharts of and after FIG. 7).
     FIG. 2 shows one example of a directory structure
of an information file recorded by the apparatus of

FIG. 1 (universal DVD-RTR recorder compatible with DVD video and other DVD family in reproducing). The video files of air check recording of TV broadcast is managed by a sub directory called DVD-RTAV. The directory DVD-RTAV includes a VMG file for storing management information (VR_MANGR.IFO), a movie video file for storing dynamic image information (VR_MOVIE.VRO), a still picture video file for storing still picture information (VR_STILL.VRO), a still picture audio file for storing additional audio information (VR_AUDIO.VRO) for a still picture, and a VMG backup file storing backup information (VR_MANGR.BUP) of management information. Moreover, in DVD-RTR, one video file is stored in one disc. Furthermore, other audio files can be managed by a sub directory called AUDIO-TS.

FIG. 3 shows one example of a data structure of information (video object VOB) recorded by the apparatus of FIG. 1. A content of the file stored in the movie video file VR_MOVIE.VRO of FIG. 2 is recorded as a group of one or more video objects VOB (video object set VOBS). Each VOB can be specified by a corresponding ID number (VOB_IDNi). Each VOB is constituted of a group of one or more video object units VOBU. Each VOBU includes video data constituted of one or more groups of pictures of MPEG (GOP), and is constituted of real time data information (RDI) pack, video (V) pack, audio (A) pack, and the like. The V or

RDI pack is disposed in the top of each VOBU, and the top pack includes a system header (not shown). The system header is disposed only in the top pack in one VOBU.

5   Additionally, as not shown, each VOBU is constituted of a video part and audio part. The video part includes a V pack group and subpicture (SP) pack. The audio part includes an A pack group. The V pack group can include a sequence header, GOP header,

10   I-picture, sequence end code, and subpicture unit. Moreover, A pack group can include a plurality of audio frames.

      FIG. 4 shows one example of a data structure of management information (M_VOB_STI, and the like)

15   recorded by the apparatus of FIG. 1. As shown in FIG. 4, the management information stored in the VMG file includes RTR video manager information RTR_VMGI, movie AV file information table M_AVFIT, still picture AV file information table S_AVFIT, original program

20   chain information ORG_PGCI, user-defined program chain information table UD_PGCIT, text data manager TXTDT_MG, and manufacturer information MNFIT.

      The table M_AVFIT includes movie AV file information table information M_AVFITI, one or more

25   pieces of movie VOB stream information M_VOB_STI#1 to M_VOB_STI#n, and movie AV file information M_AVFI.

      Each M_VOB_STI (each of #1 to #n) includes a video

attribute V_ART, number of audio stream AST_Ns, number
of subpicture stream SPST_Ns, audio attribute A_ARTO of
stream #0, audio attribute A_ART1 of stream #1,
reserved area, and subpicture color pallet SP_PLT.

5   The audio attribute A_ART (each of A_ARTO and
A_ART1) includes an audio coding mode (audio
compression mode), application flag, quantizing DRC,
sampling frequency fs, number of audio channels, bit
rate information, and the like.

10   For the audio coding mode (audio compression
mode), (a) "000b" indicates Dolby AC3 (R), (b) "010b"
indicates MPEG1 or MPEG2 having no extension bit
stream, (c) "011b" indicates MPEG2 having the extension
bit stream, and (d) "100b" indicates linear PCM. Eight
15 modes can be identified by three-bit audio coding mode,
but modes other than (a) to (d) are reserved for the
future.

      An application flag "00b" indicates that the
corresponding audio stream includes audio data of
20 a channel mode defined by "audio channel number",
and "01b" indicates that the corresponding audio stream
can include the audio data of a multi-channel mode
(monaural, dual-monaural, and stereo). In the
application flag "01b", "audio channel number" defines
25 each mode of the corresponding audio stream.

      In the audio coding mode "000b", quantization/DRC
is set to "11b". In the audio coding mode "010b" or

"011b", quantization/DRC is set to "00b (no dynamic range control data in the MPEG audio stream)" or "01b (there is dynamic range control data in the MPEG audio stream)". In the audio coding mode "100b", quantization/DRC is set to "00b (16 bits)". Other audio coding modes are reserved.

For the sampling frequency fs, "00b" indicates 48 kHz. Other sampling frequencies are reserved.

For the audio channel number, "0000b" indicates one channel (monaural), "0001b" indicates two channels (stereo), and "1001b" indicates two channels (dual-monaural). Moreover, "0010b" to "0111b" indicate multi-stereo (surround) or multi-monaural with three to eight channels. Here, when the audio coding mode (audio compression mode) is "100b (linear PCM)", two or less channel is set ("0000b", "0001b", or "1001b").

For the bit rate, 64 kbps to 384 kbps are set by "0000 0001b" to "0000 1011b" (for AC3 and MPEG1 audio). When the bit rate is "0000 1100b", 384 kbps is designated (for AC3). Moreover, with the bit rates "0000 1101b" and "0000 1110b", 768 kbps and 1536 kbps are designated, respectively (for linear PCM).

In summary, when the application flag is "00b", the corresponding audio stream is defined by the channel mode described in "audio channel number". When the application flag is "01b", the representative mode (monaural, dual-monaural, or stereo) of

the corresponding audio stream is defined.

The same information as that of the "audio channel number" (monaural = "0000b", two channel stereo = "0001b", dual-monaural = "1001b") can be recorded in the data (header) of each audio stream. The audio channel number information is set in the audio decoder 630 of FIG. 1 at the start of reproducing. The audio decoder 630 decodes the audio stream reproduced with the set sound mode (monaural, stereo, or dual-monaural).

FIG. 5 shows a pack structure of audio information (linear PCM audio) recorded by the apparatus of FIG. 1. As shown in FIG. 5, one pack (2048 bytes) of the linear PCM (LPCM) is constituted of a pack header, packet header, sub stream ID, and LPCM data. The packet header includes stream ID = 0xbd (or "1011 1101b") indicating a private stream 1. Moreover, sub stream ID is "1010 000*b" indicating the linear PCM. Here, * denotes an audio stream number (0 or 1).

The LPCM data subsequent to the sub stream ID includes audio frame information, audio data information, and data main body of LPCM. Moreover, the audio data information can store "audio channel number" information (monaural = "0000b", two-channel stereo = "0001b", dual-monaural = "1001b").

TV broadcast recording of bilingual broadcast can be indicated by "audio channel number" = "1001b"

indicating the dual-monaural mode.

FIG. 6 illustrates a pack structure of audio information (MPEG audio) recorded by the apparatus of FIG. 1. As shown in FIG. 6, one pack (2048 bytes) of MPEG audio is constituted of a pack header, packet header, and MPEG audio data. This packet header includes stream ID = 0(c0 (or "1100 000*b") indicating MPEG audio or 0(d0 (or "1101 000*b"). Here, * indicates audio stream number (0 or 1). For the MPEG audio, there is no sub stream ID.

The MPEG audio data subsequent to the packet header includes a plurality of audio access units (AAU) as a unit of audio decode. Here, AAU is a minimum unit which can individually be decoded to the audio signal), and constantly includes data having a constant sample number. Each AAU includes an error check code and audio data. The header includes a synchronous word, ID information, layer information, ..., mode information, and the like. (Other information such as a protection bit, bit rate index, sampling frequency, padding bit, and private bit are disposed before the mode information. Moreover, mode expansion information, copyrights information, original or copy information, and emphasis information are disposed after the mode information.)

The mode information is constituted of two bits, "00b" indicates stereo, "01b" indicates joint stereo,

"10b" indicates dual channel (dual-monaural), and "11b" indicates single channel (monaural). The mode information is "10b" indicating dual-monaural in bilingual broadcast recording. During playback

5 (or reproduction) of the disc after recording, the audio decoder 630 of FIG. 1 reads the mode information, and the mode is automatically changed to a mode (dual-monaural decode mode designated by "10b") designated by the content of the read mode information.

10 Various operations of the apparatus of FIG. 1 will next be described with reference to a flowchart. FIG. 7 is the flowchart showing the whole operation of the apparatus of FIG. 1. Each processing of the flowchart is controlled by the main MPU section 604

15 of FIG. 1. The main MPU section 604 executes a predetermined initial setting (step ST10) after starting the apparatus. Thereafter, key input from a user (key input from a remote controller (not shown) or operation command from reserving/recording program)

20 is waited for. When there is a key input (step ST20), the input key is interpreted (changeover command of TV received channel, recording start command, reproducing start command, and the like) (step ST30).

When the input key is interpreted as "the

25 changeover command of TV received channel", a processing of changing the received channel of the TV tuner 613 is performed (step ST40). The processing of

changing the received channel includes not only
a channel changing in the same broadcast band (e.g., 1
to 12 ch of VHF band) but also a channel changing over
different broadcast bands (e.g., VHF 1 ch to BS digital
103 ch).

When the input key is interpreted as "recording
start command", the recordable optical disc (DVD-RAM
disc, and the like) 100 inserted to the disc drive 609
is subjected to a recording processing (step ST50).

When the input key is interpreted as "reproducing
start command", a reproducing processing from the
optical disc (DVD-RAM disc, DVD-RW disc, DVD-R disc, or
DVD video disc) is performed (step ST60).

FIG. 8 is a flowchart of an operation for
selecting a broadcast program in the apparatus of
FIG. 1. Here, it is assumed that a sound language for
use in default is stored beforehand in the work RAM
604a (or a not-shown data storing memory) regarding
playback of DVD video by the apparatus of FIG. 1.

First, a channel change command from the user (or
reserving/recording program) is issued to the TV tuner
613 (step ST400). The TV received channel is changed
in accordance with the received command in the TV tuner
613 (e.g., the present TV received channel VHF 1 ch is
changed to VHF 3 ch).

The sound mode of TV broadcast received by the TV
tuner 613 after changing of the received channel is,

for example, monaural broadcast, bilingual broadcast
(dual-monaural broadcast: for example, for a content,
main sound is Japanese, and sub sound is English), or
stereo broadcast. The sound mode of the TV broadcast

5   received by the TV tuner 613 is detected by the
bilingual broadcast detector 900 (step ST402).

When the detected sound mode is not bilingual
(dual-monaural) (no in step ST404), the TV tuner 613
outputs the sound of the received TV broadcast as

10   two-channel stereo (step ST406). Additionally, when
the detected sound mode is monaural, the same monaural
signal is distributed and outputted to two channels
(L = R).

When the detected sound mode is bilingual (dual-

15   monaural) (yes in step ST404), the main MPU section 604
judges whether or not the sound mode of the TV
broadcast is set in accordance with the audio language
code set for the DVD video (step ST408). The user
designates whether or not the sound mode is tuned to

20   the audio language code set for the DVD video.

The user judges that the sound mode of the TV
broadcast is not to be tuned to the audio language
for the DVD video (no in step ST408). In this case,
for example, a graphic user interface GUI (not shown)

25   outputted to the display 608 or the external TV 637 is
used to output the sound (dual-monaural: the main sound
is Japanese and sub sound is English) of the received

channel (subjected to changing designation) to two
channels (L/R) as it is) (step ST410).

The user judges that the sound mode of the TV
broadcast is to be tuned to the audio language (e.g.,

5   English) for the DVD video (yes in step ST408).
In this case, the main MPU section 604 checks the
language code for use in the DVD video from a parameter
table (not shown) for the DVD video stored in the work
RAM 604a. When the language code is, for example,

10   English, the sub sound (English) of the received TV
channel is distributed and outputted to two channels
(L = R) (step ST412). Alternatively, when the language
code is Japanese, the main sound (Japanese) of the
received TV channel is distributed and outputted to the

15   two channels (L = R) (step ST412).

Subsequently, the sound outputted in step ST406,
ST410 or ST412 is recorded, for example, in the DVD-RAM
disc 100.

Additionally, a case in which the language code

20   for present use in the DVD video is the same as the
language of the subsound of bilingual broadcast has
been described above. However, when the language code
for present use in the DVD video is different from the
language of the subsound of bilingual broadcast,

25   several variations are considered in processing methods
of steps ST408 and ST412.

That is, when the present language setting of

the DVD video is other than Japanese (e.g., German), and even when the language of the subsound is any language (e.g., English, German, or French), there is a method of distributing and outputting the subsound to

5   two channels (L = R). This method is not suitable for a case in which the MPU section 604 cannot obtain the information for specifying the type of the subsound language of the received bilingual broadcast.

Alternatively, when the language setting of the

10   DVD video is English, there is a method of distributing and outputting the subsound (any language) to two channels (L = R). This method is suitable for distributing and outputting the subsound of any foreign language (there is usually a highest possibility of

15   English) to two channels (L = R).

As described above, when the sound language setting of the DVD video is reflected in setting of recording/reproducing of DVD-RTR, a digital recording/reproducing apparatus (DVD-RTR recorder) can

20   be realized without intricacy of setting.

FIG. 9 is a flowchart of a recording operation in the apparatus of FIG. 1. The main MPU section 604 reads each file system data from the disc 100 inserted in the disc drive 609 (step ST500). A used capacity is

25   calculated from the read data, and it is checked whether or not there is a free space (or a vacant capacity) in the disc 100. When there is no free space

(no in step ST502), a warning indicating that "there is
no recording space" is displayed in the display 608 or
TV 637 (step ST504), and the processing is ended. When
there is a free space (yes in step ST502), a managing
5 file (VMG file) is read from the disc 100. When there
is not managing file, a new VMG file is prepared and
developed in the RAM 604a (step ST506).

After recording preprocessing is performed (step
ST506), setting shifts to a recording initial setting
10 (step ST508). In the recording initial setting, the
STC 650 is reset, a writing start address and writing
command are set to each drive (disc drive 609, and the
like), and the formatter 619 is subjected to initial
setting (setting of divisions of cell CELL, video
15 object unit VOBU, program PG, and program chain PGC),
and the like. Subsequent to the initial setting,
recording start setting is performed (step ST510).
In the recording start setting, the recording start
command is set to the encoder section 601, and
20 segmenting information (division set in step ST508) is
registered as the video object VOB.

When recorded data for "one contiguous data area
(DCA)" is stored in the temporary storage 700 (yes in
step ST512), the writing address and writing length are
25 determined in the disc drive 609, and writing command
is issued to the disc drive 609 (step ST514). When
there is an interrupt for taking the segmenting

information (yes in step ST516), the segmenting
information is extracted from the formatter 619 (step
ST518). In other words, the image and sound signals
taken into the encoder section 601 is A/D converted,
5   respectively, and compressed by the encoders 616, 617.
When a constant amount (one CDA) of compressed data is
accumulated (yes in step ST512), the data is recorded
in the disc 100. In this case, the segmenting
information of the compressed data is taken into the
10   work RAM 604a (step ST518). During recording (no in
step ST520), the processing of steps ST512 to ST518 is
repeated.

When the recording ends (yes in step ST520),
a recording end processing is executed (step ST530).
15   In the recording end processing, the remaining
segmenting information is taken from the formatter 619
and initialized, and setting of program chain
information PGCI (segmenting information, I-picture
information, and the like) is written into the
20   management information VMG. In other words, the
remaining segmenting information is taken into the work
RAM 604a, and the management information VMG is updated
based on the taken segmenting information. In this
case, the sound mode having a largest number of packs
25   in recording is recorded in stream information STI
(M_VOB_STI# of FIG. 4) in accordance with the sound
mode (monaural, dual-monaural, or stereo) of the

segmenting information (STI setting processing
described later with reference to FIG. 11). Generally
speaking, the stereo sound mode is most in TV recording
of a music program, and the dual-monaural mode is mot

5   in TV recording of foreign movie with Japanese
subtitles.

     FIG. 10 is a flowchart of an interrupt processing
in the apparatus of FIG. 1. In the interrupt
processing, there are various factors for an interrupt,

10   and first the interrupt factors are checked (step
ST70). When the interrupt factor is, for example,
"interrupt processing at the end of transfer of one
pack to D-PRO 610", an interrupt processing Recpack++
for counting up the number of recording packs is

15   executed (step ST72). Moreover, when the interrupt
factor is, for example, "interrupt processing during
extracting of segmenting information from formatter
619", an interrupt flag for extracting segmenting
information 1 is set (step ST74). As not shown,

20   an interrupt flag for extracting segmenting information
x (x = 1, 2, 3, ...) is appropriately performed. After
the interrupt processing for each interrupt factor is
performed as described above, the processing returns to
another flow of processing.

25   FIG. 11 is a flowchart of a setting processing of
stream information (STI) in the apparatus of FIG. 1.
This processing is executed as a part of step ST530 of

FIG. 9. First, a state (monaural, dual-monaural, or
stereo) of the sound mode during recording is checked
from the segmenting information taken into the work RAM
604a (step ST5300). The sound mode having a largest

5   number of recordings is checked among the checked sound
modes (step ST5302). When the monaural sound mode has
the largest number of recordings, the "audio channel
number" of the stream information STI (M_VOB_STI# of
FIG. 4) is set to "monaural: 0000b" (step ST5304).

10   When the dual-monaural sound mode has the largest
number of recordings, the "audio channel number" of the
stream information STI is set to "dual-monaural: 1001b"
(step ST5306). When the stereo sound mode has the
largest number of recordings, the "audio channel

15   number" of the stream information STI is set to "2 ch
stereo: 0001b" (step ST5308).

FIG. 12 is a flowchart of an encoding processing
of audio data in the apparatus of FIG. 1. First, the
main MPU section 604 reads attribute information (A_ATR

20   of FIG. 4) of a sound A/D converted and taken into
the encoder section 601 from the TV tuner 613 (step
ST5400). The sound mode is checked from the content of
the read attribute information ("audio channel number")
(step ST5402). When the sound mode is monaural,

25   monaural is set in the header of a sound stream
(FIG. 6) (step ST5404). When the sound mode is
dual-monaural, dual-monaural is set in the header of

the sound stream (step ST5406). When the sound mode is
stereo, stereo is set in the header of the sound stream
(step ST5408). After the information of the sound mode
is set in the header of the sound stream, a compression
5   processing of the sound data (e.g., compression
processing of MPEG audio) is executed (step ST5410).
Additionally, when the sound data is recorded as linear
PCM, setting of steps ST5404 to ST5408 is performed
with respect to the "audio channel number" of FIG. 5,
10   and the processing of step ST5410 corresponds to linear
PCM encoding.

     FIGS. 13 and 14 are flowcharts showing the whole
reproducing operation in the apparatus of FIG. 1.
First, reading is started from lead-in of the disc 100
15   inserted in the disc drive 609, and it is checked
whether or not the disc is normally read (step ST600).
The disc is not normally read and it is judged that the
disc 100 has a problem (NG in step ST600). Then, an
error processing (displaying of error in the display
20   608 and/or the TV 637) is performed (step ST602), and
the reproducing processing ends. On the other hand,
the disc 100 can normally be read (OK in step ST600),
and it is then checked whether or not the information
of a volume structure is recorded in the disc 100
25   (step ST604). When the volume structure is not
recorded (no in step ST604), "not recorded" is
displayed in the display 608 and/or the TV 637

(step ST606), and the reproducing processing ends.

When the volume structure is recorded (yes in step ST604), presence/absence of the directory of DVD-RTR (DVD-RTAV in FIG. 2) is checked in a recorded hierarchy file (step ST608). If there is no DVD-RTR (DVD-RTAV) directory (no in step ST608), "not recorded" is displayed (step ST606), and the reproducing processing ends. If there is DVD-RTR (DVD-RTAV) directory (yes in step ST608), the presence/absence of the error is checked (step ST610). If there is an error (yes in step ST610), "error has been found in file system" is displayed in the display 608 and/or the TV 637 (step ST612) and the reproducing processing ends.

If there is no error (no in step ST610), recording of management information VMG (VR_MANGR.IFO of FIG. 2) is checked (step ST614). When VMG is not recorded (no in step ST614), "not recorded" is displayed (step ST616) and the reproducing processing ends. When the VMG is recorded (yes in step ST614), VMG file is read (step ST618), and preparation for reproducing is performed. Here, the main MPU section 604 reads the stream information STI which belongs to the VOB to be reproduced, and sets the respective decoders (627 to 630) in the decoder section 602 in accordance with the information in STI.

When VRO file (VR_MOVIE.VOR of FIG. 2, and the like) is not recorded in the read VMG directory (no in

step ST620), "not recorded" is displayed (step ST616)
and the reproducing processing ends. when the VRO file
is recorded in the read VMG directory (yes in step
ST620), a program chain to be reproduced (original PGC,

5   user-defined PGC#1, user-defined PGC#2, and the like)
is determined (step ST622). Subsequently, the content
of the stream information STI (any one of M_VOB_STI#1
to #n) in VMG read in step ST618 is read, and the MPEG
video decoder 628, subpicture decoder 627, and audio

10   decoder 630 of FIG. 1 are subjected to the initial
setting (step ST624). This continues to <node A> of
FIG. 14.

The stream information STI read in step ST624
includes the audio attribute information A_ATR (see

15   FIG. 4) which has the "audio channel number". The main
MPU section 604 of FIG. 1 checks whether or not the
sound mode of the title to be reproduced is "bilingual"
(i.e., whether or not "audio channel number" is "1001b"
indicating the dual-monaural mode) based on the content

20   ("audio channel number") of the stream information STI
(step ST626). With the bilingual mode (yes in step
ST626), it is further checked whether or not the audio
language code of the DVD video is to be followed (step
ST628).

25   When the code is followed (yes in step ST628), the
audio language code of the DVD video (set by the user
during initial setting, e.g., English) is read from

the work RAM 604a, and the subsound (English) of the
bilingual mode is selected in accordance with sound
language code (English). The audio decoder 630 is set
so that the selected subsound is outputted via both

5   channels (L/R) (step ST630). When the code is not
followed (no in step ST628), the sound (e.g., Japanese
main sound or English sub sound) designated for
reproducing of DVD-RTR by the user via GUI is selected
from the sound of the recorded TV channel. The audio

10 decoder 630 is set so that the selected subsound is
outputted via the both channels (L/R) (step ST632).
When the sound mode of the title to be reproduced is
stereo (no in step ST626), the processing of steps
ST628 to ST632 is slipped. Then, the audio decoder 630

15 is set so that the recorded stereo sound is outputted
via the both channels (L/R).

After the audio decoder 630 is set as described
above, a cell reproducing processing (step ST640) is
performed. During reproducing (no in step ST642), the

20 next cell is set in accordance with the program chain
information PGCI (original PGCI or user-defined PGCI)
in the VMG file (step ST644). In this case, when the
sound mode changes (to the stereo mode from the dual-
monaural mode), and the setting of audio decoding is

25 changed (yes in step ST646), the setting of the audio
decoder 630 is changed by the next sequence end code
(step ST648). When the setting of the audio decoding

is not changed (no in step ST646), the setting of step
ST648 is not changed. When the reproducing continues
to the next cell in a seamless mode (yes in step
ST650), the processing returns to the cell reproducing

5   processing of step ST640. When the reproducing
continues to the next cell in a non-seamless mode (no
in step ST650), the MPEG decoder is set to a free run
mode, a seamless connection flag (not shown) is set
(step ST652), and the processing returns to the cell

10   reproducing processing (step ST640).

After the cell reproducing ends (yes in step
ST642), the error is checked (step ST660). When there
is no error (no in step ST660), the other processing
for ending the reproducing is executed (step ST662),

15   and the reproducing processing of FIGS. 13 and 14 ends.
When the error occurs at the end of reproducing (yes in
step ST660), "read error occurs" is displayed in the
display 608 and/or the TV637 (step ST664), the
reproducing end processing (step ST666) is executed,

20   and the processing returns to other processing state
(e.g., the key input waiting state of step ST20 of
FIG. 7).

Additionally, the processing of steps the ST626,
ST628, ST630 and ST632 of FIG. 14 corresponds to the

25   processing of steps ST404, ST408, ST412 and ST410 of
FIG. 8.

FIGS. 15 and 16 are flowcharts showing one example

of a concrete content of a cell reproducing processing
(step ST640) in the apparatus of FIG. 1. First, a cell
start position FP (logic block number LBN) and end FP
(LBN) are determined based on the program chain

5   information PGCI and time map information TMAPI
included in the management information VMG.
Subsequently, read FP is set as cell start FP, and
"end address - start address" is set as a remaining
cell length (step ST6400). A start address and read

10   length of contiguous data area CDA to be read are set
(step ST6402). When the read CDA length is smaller
than a remaining cell length (yes in step ST6404),
"remaining cell length-length of the CDA to be read" is
set as the remaining cell length, and the read length

15   is set as CDA length (step ST6406). On the other hand,
when the length of the CDA to be read is not less than
the remaining cell length (no in step ST6406), the read
length is set as the remaining cell length, and the
remaining cell length is set to 0 (step ST6408).

20   Subsequently, the data read command is set to the
disc drive 609 (step ST6410), and transfer start of the
read data is waited for. The transfer starts (yes in
step ST6412), and one VOBU of the read data is
accumulated in the buffer memory (not shown). When the

25   one VOBU of data is accumulated in the buffer memory
(yes in step ST6414), one VOBU of data is read from the
buffer memory (step ST6416), and the pack constituting

the VOBU is checked. When there is RDI pack (FIG. 3) in the top of VOBU (yes in step ST6418), and there is a change in aspect ratio (yes in step ST6420), a direct-current component of a chromatic signal (C signal) outputted via video terminal S after decoding is appropriately changed (step ST6422). This continues to <node B> of FIG. 16.

When the seamless connection flag (set in step ST652 of FIG. 14) in the VOBU data read in step ST6416 is set (yes in step ST6424), "read FP+read length" is set as read FP, and MPEG decoder is set to a normal mode. Moreover, a system clock reference SCR is appropriately read and set, and the seamless connection flag is reset (step ST6426).

When the transfer started in step ST6412 of FIG. 15 does not end (no in step ST6428), there is a key input in step ST20 of FIG. 7 (yes in step ST6430), and a special reproducing mode is fast forward FF (yes in step ST6432), a jump direction for the fast forward is set to a positive direction, and a read position read_fp is set in accordance with the jump amount (step ST6434). On the other hand, when a special reproducing mode is not the fast forward FF but a fast rewind FR (no in step ST6432, yes in step ST6436), the jump direction for the fast rewind is set to a negative direction, and the read position read_fp is set in accordance with the jump amount (step ST6438).

When the read position read_fp during FF or FR
operation, a processing of contiguous data area DCA for
the special reproducing (FF or FR) is performed (step
ST6440), and the processing returns to step ST642 of

5   FIG. 14.

Additionally, in DCA processing of step ST6440,
the read position read_fp can be determined based on
the time map information TMAPI referred to in step
ST6400 of FIG. 15 in consideration of the jump amount.

10   Moreover, if there is no key input (no in step ST6430),
or even if the key input is neither FF key nor FR key
(no in step ST6432, no in step ST6436), the processing
returns to step ST6414 of FIG. 15 via <node C>.

When the transfer started in step ST6412 of

15   FIG. 15 ends (yes in step ST6428), and the remaining
cell length is zero (yes in step ST6450), this is an
end of the cell. Therefore, the processing of FIGS. 15
and 16 ends, and the processing returns to step ST642
of FIG. 14. When the remaining cell length is not zero

20   (no in step ST6450), the processing returns to step
ST6420 of FIG. 15 via <node D>.

Additionally, in the aforementioned embodiment,
"the setting which is associated with the language of
the sound already set in DVD video reproducing" is

25   automatically reflected in setting of DVD video
recording. As expansion/modification, "the setting
which is associated with the language of the set sound"

can automatically be reflected in setting a received
sound of the TV tuner 613 of FIG. 1 (or a single TV
tuner unit connected in i link (R) via IEEE 1394
interface (not shown)). Concretely, the tuner received

5   sound having the content set in step ST412 of FIG. 8
can not only be recorded in the disc 100 of FIG. 1 but
also be outputted via the speaker 633 of FIG. 1
(without being recorded in the disc 100).

     Furthermore, similarly as the method of

10   automatically reflecting the setting associated with
the set language in the setting of video recording",
"the setting associated with the language of the
subpicture already set in the DVD video reproducing"
can automatically be reflected in selecting the

15   language displayed in the monitor during reception of
character broadcast.

     FIG. 17 is a diagram showing contents of
management information to be recorded by the apparatus
of FIG. 1. Here, explanation will be given to a case

20   where information of the volume space shown in
FIG. 17(b) is recorded in the information recording
area of a DVD-RAM disc (100) shown in FIG. 17(a).
(Note that the data structure of information to be
recorded on storage unit (such as an HDD) 700 may be

25   the same.)

     The volume space of the disc (100) includes,
as shown in FIG. 17(b), a recording area of

a volume & file management information and a data area
of user data (AV information or the like). As shown in
FIG. 17(c), the data area can record management
information RTR_VMG and contents (video object VOB

5   constituting the AV information, or the like) of the
user data. Management information RTR_VMG is stored as
a file of video manager VMG.

Management information RTR_VMG includes, as shown
in FIG. 17(d), RTR video manager information RTR_VMGI,

10   movie AV file information table M_AVFIT, still picture
AV file information table S_AVFIT, original program
chain information ORG_PGCI, user-defined program chain
information table UD_PGCIT, text data manager TXTDT_MG,
and manufacturer's information MNFIT.

15   Incidentally, program chain information PGCI has a
data structure representing a whole reproduction of
program chain PGC, and the PGC represents a sequence of
program PG (or a program set). The PG is a logical
unit of the recorded contents. The PG is recognized or

20   defined by a user. The PG in a program set is formed
of one or more original cells (which are reproduction
units of the initial recorded contents), and the PG is
defined only within the ORG_PGCI. In other words, the
ORG_PGCI is the information by which an order of

25   reproduction of cells corresponding to the initial
recorded contents is described. On the other hand, the
UD_PGCIT denotes a table which describes one or more

PGCI's being subjected to a user's edition after
recording.

The M_AVFIT includes, as shown in FIG. 17(e),
movie AV file information table information M_AVFITI,
one or more pieces of movie VOB stream information
M_VOB_STI#1 to M_VOB_STI#n, and movie AV file
information M_AVFI. The M_AVFI includes, as shown in
FIG. 17(f), movie AV file information general
information M_AVFI_GI, one or more movie VOB
information search pointers M_VOBI_SRP#1 to
M_VOBI_SRP#n, and pieces of movie VOB information
M_VOBI#1 to M_VOBI#n corresponding in number to the
number of the search pointers.

Each of the M_VOBI#'s includes, as shown in
FIG. 17(g), movie VOB general information M_VOBI_GI,
seamless information SMLI, audio gap information AGAP,
and time map information TMAPI. The TMAPI may be
utilized when a special playback (e.g., a playback of
cells in a special order defined by an independent user
using the user-defined PGC) or a time search is to be
performed.

The TMAPI includes, as shown in FIG. 17(h), time
map general information TMAP_GI, one or more time
entries TM_ENT#1 to TM_ENT#r, and one or more
VOBU_ENT#1 to VOBU_ENT#q.

Each TM_ENT includes, as shown in FIG. 17(i),
VOBU_ENTN indicating the corresponding VOBU entry

number, TM_DIFF indicating a time difference between
the playback start time of the VOBU being designated by
the time entry and the calculated playback time, and
VOBU_ADR indicating the address of the target VOBU.

5   In the NTSC, when a time unit TMU is represented by 600
fields (or in the PAL, when the time unit TMU is
represented by 500 fields), the above-mentioned
"calculated playback time" with respect to the time
entry #j can be represented by TMU x (j-1) + TM_OSF.

10   The VOBU_ADR represents the target VOBU address by the
total size of the preceding VOBU's of the VOB wherein
the size of the VOBU is expressed in unit of a sector.

According to the data structure as exemplified
above, when a playback has to be started from an

15   intermediate point of a VOBU, it is necessary to
determine its access point. This access point is
called a time entry point. The time entry point is
located at a place being deviated from the position,
indicated by the movie address information of the VOBU,

20   by the time difference, indicated by the time
difference information TM_DIFF in the time entry
TM_ENT. This time entry point is a specific playback
start point (or time search point) indicated by the
time map information TMAPI.

25   Each VOBU entry includes, as shown in FIG. 17(i),
reference picture size information 1STREF_SZ, VOBU
playback time information VOBU_PB_TM, and VOBU size

information VOBU_SZ. Here, the VOBU_PB_TM indicates
the playback time of the corresponding VOBU in unit of
a video field. The reference picture size information
1STREF_SZ indicates the size of the first reference

5   picture (corresponding to an I-picture of the MPEG) in
the corresponding VOBU in unit of a sector.

       Incidentally, in the VOBU entry, the "time
interval of VOBU's" is represented by the number of
fields. However, as another method, the "time interval

10   of VOBU's" may be represented by the count value of a
clock counter, the count value indicating the interval
from one VOBU to the next VOBU. More specifically, the
"time interval of VOBU's" may be represented by the
differential value of the "presentation time stamp PTS

15   at the leading point of one VOBU" and the "PTS value at
the leading point of the immediately followed VOBU."
In other words, it is possible to represent the time
interval in a specific unit by the differential value
of clock counts within that unit.

20   As described above, according to the digital
recording/reproducing apparatus of the present
invention, the setting associated with the language of
the sound (already completed) is reflected in setting
of recording/reproducing of DVD-RTR, and setting

25   intricacy can be solved.
       Additional advantages and modifications will
readily occur to those skilled in the art. Therefore,

the invention in its broader aspects is not limited to
the specific details and representative embodiments
shown and described herein. Accordingly, various
modifications may be made without departing from the
5   spirit or scope of the general invention concept as
defined by the appended claims and their equivalents.